Images of Technology in Popular Films: Discussion and Filmography

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From at least 1925 to the present, science and technology have been depicted largely negatively in popular films of all genres. The images of science and technology in films reflect consistent public anxiety over the linkage between science, technology, and corporate power; the complacency of government agencies and scientists toward new knowledge and artifacts; the insensitivity of scientists toward the moral implications of their research and its applications; and the co-option of technical knowledge by vested corporate and government interests. Public conservatism is reflected in the suspicion toward new knowledge and new artifacts and in questioning whether science and technology truly improve the human condition.

Given the persistent popular association of science and technology with social progress and personal well-being, it is startling to discover that in films since the mid-1920s they have been depicted largely negatively. In the course of research for his book *Nuclear Fear,* a history of public perceptions of atomic energy, Spencer Weart identified a large number of films featuring a mad scientist (Weart 1988a, 1988b). In an essay on the science-fiction film genre, Harlan Ellison (1984) reviewed the antiscience bias that dominated films made in the 1930s and 1940s. In a more comprehensive sampling of all films released in the United States from 1939 to 1976 (4,541 of 15,137 films

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released), Comstock and Tully (1985) found that 162 had an act of scientific or technological innovation as a central theme. In 40% of these (including comedies), and in almost 60% of the science-fiction films, the innovation had negative consequences for people other than the innovator, including "death[,] . . . individual harm or injury, and unfortunate natural events or disasters" (Comstock and Tully 1985; see also Gerber 1987).

The number of films that contain explicit comments on the social relations of science or technology is, of course, very much larger than this. Many recent films of this type have been enormously popular and some have won wide critical acclaim. *E.T.*, for example, triggered a series of films in which scientists or technologists are depicted as heartless or so committed to solving a technical problem that they are blind to its moral dimension. Among these films are *Iceman, Splash, Baby, Project X, Short Circuit,* and *The Manhattan Project.* Earlier, *A Clockwork Orange* and *Simon* mocked the ethics of scientific researchers, the former in the context of an attack on Skinnerian behavioral engineering, the latter as a parody of "think tanks."[1]

How could a culture that has for so long prided itself on technical ingenuity, and has for over forty years supported science and technology with public funds on a massive scale, so patently enjoy (as shown by their support at the box office) seeing science and technology depicted so negatively? What lessons are there in this support for students of the social relations of science and technology? This article and accompanying filmography begin to address these questions by identifying a variety of film images that indicate a pronounced ambivalence, if not intense anxiety, in the American public's relationship to its science and technology. Initially, I attempted to segregate films by category—comedy, drama, science-fiction, action, horror—only to discover how arbitrary these distinctions were (Sobchack 1981) and how irrelevant to the social commentary the film contained. In the end, I have ignored genre distinctions in favor of a focus on films containing unambiguous value judgments about scientists or engineers as people, as possessors of special knowledge, or as agents of vested interests, with a preference for films aimed at the widest audience and not explicitly about science or technology.

Powerlessness

In many films, scientists and engineers are depicted as servants of corporate, political, or military institutions, committed to executing the

at best misguided, and frequently insidious, agendas of those institutions. In *The China Syndrome,* for example, the hero nuclear power plant engineer is helplessly in thrall to a parochial utility management whose allies include the police. Kerr-McGee's nuclear services management is portrayed even less flatteringly in *Silkwood,* the story of Karen Silkwood's radiation contamination while working at a Kerr-McGee plant and her subsequent death en route to an interview with a *New York Times* reporter. In *Aliens,* the ship's corporate owners are responsible for the calamity that befalls the crew of the freighter Nostromo, whose science officer is in fact a robot "planted" on the crew and programmed to carry out the corporation's instructions at the expense of the crew's safety. It is hardly incidental that it is a science officer whose behavior and thinking are plausibly mimicked by a robot, the identity of which goes undetected until too late. In *Robocop,* technological innovation is depicted as the cynical product of corporate machinations and malevolence. In *Tucker: The Man and His Dream,* Francis Ford Coppola tells the (roughly) true story of an eccentric genius whose automotive innovations are crushed by a corporate political conspiracy effected by the "Big Three" manufacturers to avoid reengineering their own cars. The central image of *Dr. Strangelove, or How I Learned to Stop Worrying and Love the Bomb* is the amorality of scientific genius, ready to serve whoever funds the problems that fascinate it. The film *Desert Bloom* describes the anxiety suffered by a passive public as science, technology, and the federal government go about their common business, in this case initiating the Nevada atmospheric nuclear weapons test program in the early 1950s.

Technology frequently appears in films as an antihuman force. In *The Emerald Forest,* an American engineer heads a construction project building a colossal dam in the Amazon jungle. In the process, tribal lifestyles are disrupted with catastrophic consequences, among them the engineer's loss of his son to one of the tribes and the destruction of the completed dam, which the engineer himself (unsuccessfully) attempts to abet. John Boorman's message in this film echoes the message of his earlier, and far less successful, film *Zardoz*: technologies can be destructive of human well-being, and when they are they must be destroyed. In the technically brilliant, polemical documentary *Koyaanisqatsi* (a Hopi word meaning "out of balance"), technology is compared to a Saturn 5 rocket that we see rising majestically from its launching pad at the start of the film. We discover, when we return to it at the end of the film, that it has veered off course and must be destroyed, its *disjecta membra* tumbling, against a cloudless,

flawlessly blue sky, in ultra-slow motion, down to the ocean miles (and minutes) below. The message of the film is not quixotic, however. Nature is not offered to us as a benign, motherly alternative to technology, but as the austerely beautiful, undeveloped, and undevelopable American southwest: Hopi territory. We cannot go home to Nature, but technology as it has in fact developed is shown as having pushed the hoped for advance of human well-being "off course." By inference, technology's current institutionalization, like the errant Saturn 5 rocket, must be destroyed; a fresh attempt based on new institutions must be made.

Less intellectually, the "Mad Max" series of films attaches only ugliness to machinery, in spite of its being necessary for survival. In four of the five "Monsieur Hulot" films made by Jacques Tati between 1949 and 1972, the filmmaker eschews even a hint of overt violence, but makes a similar point with mordant humor. In *Jour de Fête* Monsieur Hulot attempts to incorporate the latest American technology into rural French postal service. In *Mon Oncle,* Tati mocks high-technology designs for living, and in *Monsieur Hulot's Holiday* the modern passion for organization, an instance of (Jacques Ellul's) *la technique* corrupting leisure. In *Playtime,* Tati bitterly satirizes the coming of the international style to Paris, a Paris that is recognizable as such only in two scenes when, reflected in glass, we catch fleeting glimpses of Sacre Coeur and the Eiffel Tower. Every other scene takes place in or before glass curtain-wall office and apartment buildings that could be anywhere—that define *anywhere,* defying specificity of place. The climax of the film takes place at the opening of a new "high-tech" restaurant that literally self-destructs in the course of the evening, while a "low-tech" traditional French bistro forms out of its rubble!

Surprisingly, perhaps, science-fiction films are overwhelmingly dystopian, projecting the consequences of science and technology as politically or environmentally disastrous, or as inevitably co-opted by antidemocratic vested interests. Illustrations of this in recent years are Godard's Kafkaesque *Alphaville; THX 1138* (George Lucas's first film), in which sex and love are proscribed; *Logan's Run,* in which overpopulation requires that life end at 30; John Boorman's *Zardoz,* in which a science-wielding intellectual elite lives insulated from post-nuclear war barbarism; *Soylent Green,* in which industrial development has led to environmental collapse (including greenhouse-effect warming); and *The Man Who Fell to Earth,* in which shadowy corporate figures prevent technological innovations of mass benefit that threaten their investments.

In *Amazing Grace and Chuck,* international arms merchants attempt to prevent a mass disarmament protest, not stopping at murder. The plot of *Who Framed Roger Rabbit?* revolves about an attempt to force automobiles onto southern California, at the expense of Toon Town, including the deliberate bankruptcy of the existing mass transit system. In *Virus,* an airplane accident releases a U.S.-developed germ warfare agent that depopulates the Earth. In *The Quiet Earth,* an American Defense Department experiment goes awry and kills everyone on the planet except those people who were in their death throes at the time, among them a scientist member of the project who (thought he had) committed suicide to protest its continuation. *Brazil* explicitly uncouples political tyranny from technology by depicting a rather low-technology secret police apparatus that is nevertheless as mindlessly cruel and immoral as in any high-technology dystopia. In *1984,* too, technology is not the cause of oppression, but neither does technological advance correlate with freedom. Instead, those social institutions and forces that see benefit to themselves in oppressing the masses find technology preferentially available to them.

In the "Star Wars" trilogy, as in the James Bond/007 series that began in 1960 with the undoing of the evil scientist Dr. No, prominently featured "gee whiz" technologies are ultimately irrelevant to the decisive battle between the forces of good and evil. In the Bond series, victory is never determined by the super-duper gadgetry with which Bond is invariably invested. Instead, Bond's victories are in every case determined by his superior wits, his charm, nerve, and physical skills. Similarly, in the climactic scene of *Star Wars,* as Luke Skywalker attempts to destroy the Imperial Deathstar that is about to annihilate the rebel home planet he hears the voice of his Jedi master telling him to shut off the ship's computer and to trust his instincts to guide the bombing run. In all three films it is "heart," wit, courage, and the possession of an uncorrupted version of the psychic-spiritual Force that allows the rebellion to succeed against the technologically superior Empire.

Humans pay a high price for ceding control to machines in films like *The Terminator, Colossus: The Forbin Project, Dr. Strangelove, Fail Safe,* and *2001.* In *Paris, Texas,* American society is depicted as one in which the most intimate human relationships are mediated, and warped, by technology. In the brilliantly realized *Blade Runner,* advanced androids created by an interplanetary corporation to suit its purposes are virtually indistinguishable from humans, and attempt to pass as humans back on Earth, forcing the corporation to hire bounty

hunters to kill them (or is it to murder them?). The story line is a very narrow one, but the plot is generic: our technical creations come back to taunt and threaten us, even as they labor for us and evoke love from us. It is *Frankenstein* updated: the original film version of the novel began with a formal welcome to the audience by a tuxedoed representative of the film's director who announced that the sad story about to unfold was an illustration of what happened when scientists became arrogant and lost sight of God.

Some recent films have portrayed the engineer as morally responsible for the consequences of technology. The central figure of the film *The Mosquito Coast* is an iconoclastic engineer who imposes his vision of "straight lines and right angles" on a "curved" nature, in the process causing lasting harm to nature and to people, in spite of transient triumphs. He openly mocks the incompleteness and generally unsatisfactory design of Nature as God created it, taking as the engineer's mandate putting things right. Perhaps just a little heavy-handedly, he dies of a gunshot wound inflicted by an evangelical minister he had been harassing. Francis Ford Coppola's powerful 1974 film *The Conversation* has as its central character a neurotic electrical engineer whose business is electronic surveillance and who persists in denying moral responsibility for the uses to which his clients put the information his technical genius makes available to them. His attempt to intervene in a murder plot reveals him to be a hopeless innocent in the real world in spite of his technical expertise. In the Australian film *Malcolm,* a mildly retarded young man who is a genius at constructing electromechanical devices is befriended by a petty thief and his lady. He shows his gratitude for their attention to him by building a radio-controlled robot, disguised as a trash can, with which they successfully launch a bank-robbing career. Where Coppola in *The Conversation* explicitly compares the engineer to a prostitute, *Malcolm* suggests that engineers are emotional simpletons who love to build technical toys for people who pat them on the head and give them the money to buy the parts they need, with no concern for the moral dimension of the actions they make possible.

Historical Origins of the Powerless Image

In *Shifting Gears: Technology, Literature, Culture in Modernist America,* Cecelia Tichi describes the very positive depiction of engineers in the mass media, in popular novels, and in early films, from the late nineteenth century through World War I (Tichi 1987, 97ff). The

engineer, though an "invisible man of [academic] American studies" appears "as the hero in over 100 silent movies and in best-selling novels approaching five million copies in sales between 1897 and 1920" (Tichi 1987, 98). He is the Emersonian "representative man for the era, a symbol of efficiency, stability, functionalism, and power . . . at once visionary and pragmatic" (Tichi 1987, 98). The engineer signified stability in a social environment that seemed to require constant change in accommodation to new technologies. In a corporation-dominated, gear-and-girder world, the engineer was "technology's human face" and wore the "mantle of civilizing power and ethical judgment" (Tichi 1987, 99). In the preface to *The Winning of Barbara Worth,* which sold over one and a half million copies and sat on top of the best-seller list for 1911 and 1912, author Harold Bell Wright announced: "In all the professions there can be found no finer body of men than our civil engineers" (Tichi 1987, 131).

At the same time, however, roughly from 1890 on, a sizable body of comparably popular fiction grew that was highly critical of the social impact of the new technologies then being implemented. In *Civilizing the Machine,* John Kasson refers to some 150 utopian/dystopian novels published between 1885 and 1900, many of which took as their subject the negative social consequences of the new production, distribution, communication, and transportation technologies that were transforming America (Kasson 1976; see also Segal 1985). Among these were the enormously popular *Looking Backward* by Edward Bellamy ([1888] 1951), *Caesar's Column* by Ignatius Donnelly ([1890] 1960; an inflammatory diatribe that by 1899 had even sold half-a-million copies in Europe), Mark Twain's *A Connecticut Yankee in King Arthur's Court* ([1889] 1963), and William Dean Howells's *Traveler from Altruria* ([1894] 1957).

Kasson notes the high-culture antagonism to technology in the teaching of Harvard professors Henry Adams, Charles Eliot Norton, and Ralph Adams Cram, who lauded the Middle Ages as an era of humanistic balance in the relationship between Nature and culture, as well as a "more widely shared retreat from technological America [that] was expressed in the pervasive nostalgia for the homogeneous, pre-industrial village culture of the early nineteenth century" (Kasson 1976, 188). Richard Hofstadter's *The Age of Reform* also depicts populist anxiety about, if not hostility toward, the new technological America (Hofstadter 1955, 258ff), while Leo Marx, in *The Machine in the Garden* (1964), and Herbert Sussman, in *Victorians and the Machine* (1968), document the at best ambivalent attitudes toward

technology of American and British intellectuals from Thoreau and Carlyle to Lincoln Steffens and H. G. Wells. Furthermore, at least by the mid-1920s, with the distribution of Fritz Lang's *Metropolis,* there also began to appear a stream of American, British, and European popular films that expressed negative attitudes toward technology.

There is no contradiction between the points made by Tichi and by Kasson. The figure of the engineer as a heroic champion of individualism and progress is not at all incompatible with the recognition that the promise of such individuals is thwarted by powerful vested interests that usurp engineering and subordinate it to their own parochial agendas, to society's loss and even pain. Robert Clay, the hero engineer of *Soldier of Fortune,* a novel by Richard Harding Davis (1919) that sold half-a-million copies in 1897, "recognizes that he is only a salaried employee working to please and enrich the owner of a mine" (Tichi 1987, 128). It was not engineering but selfish corporate exploitation of technology that exercised Edward Bellamy in *Looking Backward*; the power- and class-centered greed of corporate capitalism that Donnelly attacked in *Caesar's Column*; the economy of deliberate wastefulness that Veblen (1934) exposed in *The Theory of the Leisure Class*; and the systematic industrial inefficiency that was the target of Taylorism, scientific management, and the Technocracy movement. Engineering appeared to almost everyone as a body of objective technical knowledge capable of improving human existence and perhaps even human nature; technology, as a social process liable to selfish manipulation by powerful organizations and individuals with narrow vested interests. This distinction is also reflected in the emergence of the Technocracy movement after World War I. It was increasingly clear, especially to the engineers themselves, that engineering's promise of social progress was being co-opted by the profit-centered political and social agendas of industrial capitalism.[2]

As Edwin Layton describes it in *The Revolt of the Engineers,* tension between the business focus of those with the capital to underwrite the realization of new inventions and the engineers' vision of what they should be producing and how they should be producing it was an explicit controversy within the engineering professional societies virtually from their beginnings (Layton 1969a, 1969b). Every attempt at gaining true professional autonomy for engineers, however, failed. Even as their technical knowledge increased in sophistication, and even as that knowledge became increasingly indispensable to the conduct of industrial capitalism, engineers individually and as groups held less

and less power over the conduct, policies, and values of the industrial enterprises made possible by their expertise.

This subordination of engineering to managerial agendas became the norm as giant industrial corporations concentrated technical expertise, capital, and production power in enterprises of unprecedented scale. The appearance of the 150 antitechnological novels noted by Kasson was coincident with the consolidation of American industry around a relatively small number of giant corporations, holding companies, and trusts. This process of consolidation was slowed by the antitrust legislation enacted from the 1890s on, supported by such Supreme Court decisions in the early twentieth century as those upholding the dissolution of the tobacco trust and of Standard Oil. But antitrust legislation did not roll back the consolidation of industrial power in the hands of giant corporations. Even today, a very small number of corporations formed just before or after the turn of the century control the bulk of domestic production in a wide range of industries, from automobiles, chemicals, and turbine engines to tobacco products, glass, and breakfast foods.

As the number of engineers in the United States doubled every decade from 1880 through the 1960s, from some 3,000 to over 800,000, and then doubled again from the 1960s to the present, the overwhelming majority of these became employees of those same corporations or their more recent counterparts in the aerospace, defense, and semiconductor technology industries. In the novels Tichi describes, as in early films, the image of the engineer was the civil engineer dealing directly with nature on the one hand and with the client on the other. The reality of engineering, however, was more and more that engineers, now electrical, mechanical, and chemical as often as civil, worked deep within corporate environments, receiving projects from management and producing an output that would be tailored by manufacturing, sales, styling, and marketing before having an impact on nature and society.[3]

Approximately 80% of American engineers are today employed by private industry, and by 1969 70% of these were employed by just 1% of the firms employing engineers. The overwhelming majority of engineers are employed in corporate or federal government work environments with highly articulated managerial structures. Engineers receive the specification of their problems together with the terms of acceptable solutions from management. Furthermore, it is increasingly recognized that sometime during the 1960s engineering ceased to play a primary role in American industrial management, a recognition that

should alter dramatically our interpretation of America's current competitiveness problem.[4] The upshot of this coevolution of industry and engineering was the progressive disappearance of the engineer as the agent responsible for, and ultimately exercising some measure of control over, technological change. Instead, the industrial system itself, having swallowed up the engineer, now commanded that process and its rationality was not that of engineering, nor was it clear what consideration it took of the public interest.

Fictional Counterparts

In *The Octopus* (1901) and in *The Pit* (1937), two-thirds of a projected trilogy interrupted by his death, Frank Norris attempted to convey both the fact of this usurpation of the innovation process by the modern corporation and his interpretation of the rationality of the managerial system now commanding it. The narrator of *The Octopus,* Presley, witnesses a lone locomotive, racing to make up time lost to delays, hurtle through a flock of sheep crossing the tracks in the dark; the shepherd is off praying in a nearby church. The effect on the sheep is, of course, bloody devastation. The narrator sees through the particularity of this incident and links it to the network of relationships precipitated by the management of the railroad, a network made possible by new transportation, communication, and managerial technologies. Presley

> saw again, in his imagination, the galloping monster, the terror of steel and steam, with its single eye, Cyclopean, red, shooting from horizon to horizon; but saw it now as the symbol of a vast power, huge, terrible, flinging the echo of its thunder over all the reaches of the valley, leaving blood and destruction in its path; the Leviathan, with tentacles of steel clutching into the soil, the soulless Force, the iron-hearted Power, the monster, the Colossus, the Octopus (Norris 1901, 48).

Norris dismissed the popular identification of technology with artifacts in favor of identifying technology with the total managed system whose objectives artifacts serve. The impact of new artifacts on people and institutions is symptomatic of the pursuit of these objectives, a pursuit controlled from afar by men with clean hands. Norris saw further than this. Not only were the engineers who generated the particular artifacts not responsible for the terrible human impact of the system they made possible for growing, harvesting, shipping, and sell-

ing wheat, but even individual managers were not in control of the system. At the end of the book, when the railroad management's policies and actions have ruined everything and everyone Presley cared about, the broken president of the railroad tells him "railroads build themselves. . . . You are dealing with forces . . . when you speak of wheat and the railroads, not with men. . . . Men have only a little to do in the whole business" (Norris 1901, 285). Conditions may crush individuals, but blame must be put on "conditions, not men." Indeed, Behrman, the chairman of the railroad and the chief architect of its heartless but "rational" policies, in the end is suffocated in the hold of one of his own grain ships, at the very end of the wheat chain he created.

Similarly, in *The Pit,* which extends Norris's account of the wheat network to the trade in wheat futures, he writes of the Chicago Board of Trade's "centrifugal power," affecting grain in Iowan elevators, men on the streets of New York, a dozen Continental bourses and Old World banks, causing famine in northern Italy and western Prussia or plenty on the steppes and along the banks of the Ganges (Norris 1937, 74). At the end of this novel, too, the futures trader Jadwin—sympathetically depicted, unlike Behrman in *The Octopus*—reflects on his ruin: "The wheat cornered itself. I simply stood between two sets of circumstances. The wheat cornered me, not I the wheat" (Norris 1937, 402).

The cinematic "echo" of the critique of technology as corrupted by the form of its corporate and governmental institutionalization began to appear in the 1920s and continues to this day. It is fully present in Fritz Lang's *Metropolis* of 1926 and in Coppola's *Tucker* of 1988. *Metropolis* is one of a number of pre-World War II films that explored the excesses of industrial capitalism of the period, as interpreted by these filmmakers, in particular the theme of the workerless factory. The action in *Metropolis* centers on a worker revolt, deliberately precipitated by the chief capitalist in order to crush the workers now that his scientist has invented a robot that makes human workers unnecessary. Technology is depicted as resulting in a soul- and body-crushing work environment and as an instrument of social and economic oppression, but the film's story line holds out hope. At the close of the film, the revolt is stopped short of the workers' self-destruction (though they are sorely harmed); the capitalist has had second thoughts; and his son, in love with a saintly woman who urges nonviolence to the suffering workers, achieves a reconciliation between management and labor. The closing cue card tells the audience that the (managerial) mind and the (laboring) hand can only be united by the heart.

René Clair's 1931 film A Nous la Liberté is also an attack on industrial capitalism as dehumanizing, a tool of a foolish plutocracy who use it to pursue their decadent life-style at the expense of the laboring masses. In Clair's film, the hero is an escaped convict who very quickly becomes the head of a large company manufacturing record players. At the end of the film, facing exposure and arrest, he presides over the opening of his latest factory, incorporating a workerless production technology. At the dedication, he announces that he is turning the factory over to the workers, who will now become leisurely supervisors overseeing the automated assembly lines and enjoying the profits; and he escapes industrial success as well as the police by resuming the truly free vagabond life that he had previously enjoyed.

Charlie Chaplin's *Modern Times* is widely identified as a film critical of industrial technology, though it is actually a much broader critique of industrial capitalism. The most frequently shown scenes in the film are the ones in which Chaplin falls behind and disrupts the moving assembly line he works on and in which he becomes trapped in a giant gear train. More revealing, however, is the scene in which he is selected to demonstrate a device that promises to increase productivity by feeding the workers lunch as they stand at their work positions. The results are predictably catastrophic and the capitalist stalks off disgusted; but though skeptical from the first, he could not resist the sales promotion warning of the competitive advantage that companies installing this new technology would enjoy.

Inherent Dangers

One theme that emerges from the depiction of technology as a formative influence on social, political, economic, and cultural life and values, is that technical knowledge as generated by scientists and engineers may be latently progressive and good but is commonly corrupted by the manner in which it is exploited. A second theme, far less common than the first, is that certain kinds of knowledge are intrinsically corrosive of human well-being, that they inevitably precipitate personal or social disasters regardless of human attempts to control them for society's benefit. Mark Twain's *Connecticut Yankee,* for example, ends in an attack on technique as incapable of fundamentally altering human nature; and so it could not alter human history either.[5] The films *The Invisible Man, Dr. Jekyll and Mr. Hyde, The Island of Dr. Moreau,* and *The Fly,* among many others, deal with the apparently

intrinsic harmfulness of certain kinds of knowledge. Ralph Bakshi's *Wizards* is also an attack on technology as essentially antihuman, in the spirit of the late-1960s critiques of technology by Reich (1970), Rozsak (1972), Dubos (1968), and Ellul (1964), among others.[6] The British film *Things to Come* (1936), very loosely based on a fictional "history" of the future by H. G. Wells (1933), offers a particularly interesting variation on this theme. The film begins with the onset of a European war that continues for decades until a band of engineers intervenes and imposes a "rational," benevolent dictatorship of engineers working for humanity's good, as the engineers interpret it. They create a sociopolitical environment that gives unlimited scope to the practice of engineering. As generations go by, the world is transformed into a progressively wealthier human environment by this government and everyone shares in the wealth. Nevertheless, in the end, the masses rebel. They are led by an artist who expresses their displeasure at the constant change forced by the engineers' preoccupation with continually "improving" things and with the inhuman scale of the newer technologies, which beggars all nontechnological human achievement. What makes this screenplay particularly interesting is that almost none of this antitechnology is present in Wells's "history," which is primarily concerned with the kinds of political developments that could lead to a stable, rationally organized, world socialist government.

In the early post-World War II period, the British film *The Man in the White Suit* returned to the theme of the anesthesia of the scientific/technological innovators to the actual personal and social consequences of their work. The hero of the film is an erratic chemistry genius working to create a synthetic fiber that will not become dirty and will not wear out. His initial success strikes fear into both the antimanagement workers at the textile mills and the antilabor mill owners and executives. Even the chemist, Sidney Strafford, seems eventually to realize how socially disruptive his new fabric will be, but the general relief at discovering that the new fiber is unstable is premature. As Sidney departs the mill at the end of the film, apparently defeated and sobered, he suddenly straightens, pulls his lab notebook out of his pocket, mutters "I see," and, with a smile on his face, strides on energetically. He has learned nothing about the social relations of technology from his experience. His personal relations with his long-suffering landlady and with supportive fellow-workers have not changed him. The technical chemical puzzle *will* be solved by Sidney Strafford, independent of the cost to himself and others.

Ambivalence

The appended filmography lists a larger number of films, incorporating a wider range of treatments of science and technology, than I have discussed here. For example, I have not mentioned laudatory films, such as *The Story of Alexander Graham Bell, Madame Curie,* or *Breaking the Sound Barrier,* and military films, such as *Top Gun.* The whole body of these films, however, reinforces the conclusion that there is a distinct ambivalence on the part of citizens in the technologically "advanced" societies toward the social impact of technology.

Can this ambivalence be attributed primarily to an antitechnology bias on the part of the people who write, direct, and produce films? Negative attitudes may play some part, but it seems safe to conclude that the popular film industry's financial and production executives weigh public attitudes carefully before indulging the biases of directors, writers, and actors. Furthermore, as noted earlier, even so well-established a "techno-freak" as George Lucas has opposed technology to virtue in his "Star Wars" trilogy, the most technology-intensive films of their time. The Disney studios, famous for catering to a very broad audience, have made the dark side of science and technology the theme of a number of recent films, among them *Tron, The Black Hole,* and *Splash.* The films of science-literate author and director Michael Crichton (a graduate of Harvard medical school) consistently focus on the limitations of technology—for example, in *The Terminal Man,* in which a computer-based therapy for psychomotor epilepsy is subverted by the patient; in *Westworld,* in which fail-safe mechanisms built into android fantasy playmates fail; and in *Futureworld,* in which the technically perfected androids become the means for spreading human corruption.

In spite of the optimistic rhetoric that invariably surrounds the pursuit of science and technology, their ambivalent depiction in this body of popular films over a period of more than sixty years expresses widespread anxiety over their ultimate social impact. This anxiety may be partially relieved by seeing the "dark" sides of science and technology worked out on the movie screen, perhaps in the hope that that is where they will remain, but the anxiety seems to be a permanent condition of modernity.

At least as a first-order classification, it is possible to distinguish three foci of anxiety in these films. One focus is that technical knowledge itself inevitably leads beyond humanity's best interests. Pasteurization and the telephone are wonderful, but the drive that makes

certain people want to know new things and invent new things is suspect. It leads to knowing things that people should not want to know and for which they will be punished and others suffer, and to building things that ought not to be built, things that will precipitate destruction, even calamities. Mad scientist films are merely symptomatic of this broader anxiety, an articulation of a popular suspicion of people who devote their lives to discovering the unknown.

A second focus of anxiety is the form of institutionalization of science and technology, namely, the oligopolistic domination of scientific research and technological development by large corporations and government. In these films, the concentration of wealth and power overwhelms the public interest. What emerges as paramount is not the public interest, but the vested interests, and the profits, of institutions manipulating the research or the new technologies. The vastness of governmental power today, the scope of its activities, especially those involving national security, the size of its budget, and the opportunities for corruption and self-aggrandizement breed anxieties about what is being done and why. For similar reasons, the motives of corporate technological actors are suspect, the more so as self-promotion and profit are explicit corporate managerial values.

Finally, some of these films question whether technological advance bears in any significant way on the goals of making people better, illuminating the human condition, and improving the quality of life, as opposed to merely altering the physical conditions of existence.[7] Even where technology is not abused, where science does not release demonic forces, where there is no harm to the environment or to people, technological progress is depicted as ultimately inimical to human well-being. Technological advance, even in the absence of malevolent manipulation, generates temporary comfort at the expense of ultimate political or environmental catastrophe. The shortsightedness, and the selfishness, of the public's readiness to discount the future price to be paid for present well-being accounts for the way technologies are implemented and for their ultimately negative consequences.

These messages may seem a heavy burden for a collection of popular films to bear, but the films mentioned here are only a fraction of those that contain explicit comments on the social relations of science or technology. These comments have reached an enormous and a diverse audience from the 1920s through the 1980s, yet their messages, deliberately crafted to appeal to what were believed to be widely prevalent attitudes, values, and fears, have remained pretty much the same.

Appendix
Selected Filmography: Images of Technology in Popular Films

With only a few exceptions these films are available on VHS cassettes.

After Hours (1985): Not an anti- or a pro-technology film, but a black comedy in which a corporate computer user seeks low-technology "real world" fun one night after work, and is only too glad to find himself back at his terminal in the morning.

Aliens (1986): Corporate management cynically exposes a freighter crew to danger, planting on their ship a robot science officer whose program precipitates disaster.

Alphaville (1965): A Kafkaesque science-fiction detective story whose clearest message is that the future will be bleak.

Amazing Grace and Chuck (1987): A professional athlete joins a young boy in an arms protest and is murdered by arms merchants whose business interests are threatened.

A Nous la Liberté (1931): True liberty means escaping from industrial capitalism, even if you are a successful capitalist. Contains the original version of a scene, echoed five years later in Chaplin's *Modern Times,* in which a moving assembly line is disrupted by the distracted hero. In turn, *Liberté* echoes the theme of the workerless, fully automated factory as the goal of industrial managers in *Metropolis* of 1925.

Atomic Cafe (1982): A collection of news clips primarily from the early 1950s that provide an embarrassing review of prevalent attitudes toward nuclear weapons.

Baby (1985): This baby is a young dinosaur, and if you love it, the last people whose hands you want to put it in are scientists (see *E.T., Iceman, Splash*).

Berlin, A Symphony of a Big City (1928): Belongs to a set of films about the technology of filming. *Living Russia* is similar; *Medium Cool* is a conceptually more sophisticated illustration.

The Black Hole (1979): An instance of the "mad scientist" genre. Understanding the physics of black holes was supposed to be his ticket to fame and fortune; instead he ends up in one.

Blade Runner (1982): Visually superb realization of a story illustrating how selfishly exploited technologies come back to haunt, and threaten, us. Humans are insensitive to the needs of their artifact- creations however useful they may be and however much genius was expended in their creation. This was Baron Frankenstein's problem, too, and the cause of his undoing.

Brazil (1985): An actual bug causes a Ministry of Information computer printer malfunction and starts a chain of events leading to the hero's demise. An outlaw refrigeration mechanic epitomizes the film's message about technology, namely, that technology is not the cause of political oppression, just its ally.

Breaking the Sound Barrier (1952): A paean to technology and technologists.

Capricorn One (1978): Political expediency causes NASA to fake the first manned Mars mission, right down to losing the crew, for real, on reentry.

The China Syndrome (1979): A nuclear engineer finally decides to stand up to the power plant management and is shot to death for his attempt to save the public from harm.

A Clockwork Orange (1971): Most of all, an attack on Skinnerian behaviorism and the ethics of those employing it to "improve" people.

Colossus: The Forbin Project (1970): *War Games* for adults. An early instance of the group of films (including *The Terminator*) warning of the peril in automating the defense system, and of the delusion that we are in control of the technologies we create.

The Conversation (1974): The engineer as one who prostitutes his genius and attempts to deny moral responsibility for the consequences of its application. Caught up in an intrigue, he attempts to take unilateral action and fails totally either to halt the crime he abets or to understand his own role in it.

Desert Bloom (1986): The atomic scientists are perceived by the public as distant "gods" allied to the government, but the first atom bomb tests generate anxiety in this unusual growing-up-in-Nevada film.

Dr. Jekyll and Mr. Hyde (1920, 1932, 1941): In all three versions, the pursuit of knowledge is not always liberating. Motives shape what we want to know and how we respond to discovering it. *The Invisible Man*, *Frankenstein,* and *The Fly*, among many others, also treat this theme.

Dr. No (1963): The first Bond film, with none of the technical gadgetry to come, but the enemy is an amoral scientist using nuclear technology to achieve world power.

Dr. Strangelove, or How I Learned to Stop Worrying and Love the Bomb (1964): Scientists as amoral technical experts, calculating results for whomever they serve.

The Emerald Forest (1985): Technology comes to the Amazon in the form of an American-engineered dam complex. It disrupts long-standing tribal lifestyles, but all is made right by destroying the technology!

The Empire Strikes Back (1980): As in *Star Wars,* the Imperial forces have the technological edge, but the rebel heroes have courage, wit, just enough technology, and THE Force.

Fail Safe (1964): Another treatment of the fragility of the defense technologies that are supposed to make us secure and of how reliance on technology does not breed security.

E.T. The Extra-Terrestrial (1982): An extraterrestrial is stranded on Earth, for a while, but only children can be counted on to respect his sentience and rights, not the adult establishment and certainly not its "house" scientists.

The Fly (1958, 1986): See *Dr. Jekyll and Mr. Hyde.*

Frankenstein (1931): Explicitly tied, by its opening scene, to the destructive potential of science if scientists' motives are not pure.

Futureworld (1976): The sequel to *Westworld,* but broader in concept. The message of the first film, that complex machines can never be truly fail-safe, gives way here to a portrayal of the seductive character of technological power. Both of these films were written and directed by Michael Crichton, M.D., who also wrote *The Terminal Man.*

The Gods Must Be Crazy (1981): Technology condensed to a coke bottle precipitates a clash between "primitive" and "advanced" cultures in South Africa.

Goldfinger (1964): The first Bond film to focus on trick machinery. At the expense of a lovely Aston Martin coupe, it makes the point that the series would echo: technical gimmickry can hold off the enemy for a while, but only a self-reliant hero can defeat them. The contrast between Bond and Rambo as warriors against communism is striking.

Hospital (1971): Black comedy satirizing technology-intensive health care at a modern urban hospital. In contrast to the British film *Britannia Hospital* (1982), which seems a cross between *Animal House* and the *Carry On* series, this American film is convincing enough to promote thought and make the laughter nervous.

Iceman (1984): This is a thoughtful film about the moral implications of scientific research. Its story centers on the revival of a Neanderthal man from a block of Arctic ice and the problems this poses for the research station staff studying him. Mixed motives and confused values abound, but the clear message is that enthusiasm for knowledge is not enough: we need to respect it. See *Blade Runner* for the technological side of this message; and the original (1951) version of *The Thing,* in which an alien is thawed out of a block of Arctic ice, for a very different treatment of a similar plot line.

Insignificance (1985): A Nicholas Roeg film in which the lives of Einstein, Marilyn Monroe, Joe DiMaggio, and Joseph McCarthy overlap for one night. Comments on the natures of fame, power, and science, especially in a scene in which Monroe (correctly) explains the Special Theory of Relativity to Einstein with the aid of toy trains and flashlights.

The Invisible Man (1933): See *Dr. Jekyll and Mr. Hyde.*

The Iron Horse (1924): A positive depiction of the coming of the railroad, and with it, of eastern "civilization," to the wild west.

The Island of Dr. Moreau (1977): Like Dr. Frankenstein, Dr. Moreau pursues knowledge just the other side of the ethical, "humanizing" animals, physiologically and psychologically.

Jour de Fête (1949): The first Monsieur Hulot film, in which he attempts to bring American technology to the rural French postal service.

Koyaanisqatsi (1983): A visual diatribe against the way industrial technologies have been exploited. Superb cinematography in the service of an attack on technology, creator of dehumanizing work and living environments. Langdon Winner was an adviser on the film.

Living Russia: The Man with the Movie Camera (1929): With *Berlin, A Symphony* a self-reflexive study of the movie camera as a means not only of selectively recording life, but also of shaping it by calling attention to the camera itself.

Local Hero (1983): Corporate America comes to Scotland in the form of a petro-giant seeking a harbor for a refinery complex at the expense of a fishing village.

Logan's Run (1976): Life is high tech in 2274, but it ends at thirty!

The Lorax (1972): A Dr. Seuss animated film and therefore ostensibly for children; but it says it all, albeit cutely and simply, about the relationship of greed and environmental despoliation to technological innovation. It does not have a happy ending.

Mad Max (1979): Post-World War III Australia collapses into barbarism in a story laced with cars and motorcycles as monstrous as many of the survivors. The sequel was originally released as *The Road Warrior,* then as *Mad Max 2.*

Mad Max Beyond Thunderdome (1985): The third film in the Mad Max series. Preserved legends of pre-war technology conjure up a Camelot existing just beyond the edges of barbarism. Some echoes of *Canticle for Leibowitz.*

Madame Curie (1943): If genius *were* 98% perspiration, one viewing would explain why Madame Curie was a genius. Still, an impressively heroic portrait of the scientist.

Malcolm (1986): Malcolm is emotionally retarded but a genius at building electromechanical gadgets. Befriended by a petty thief and his lady, he realizes their "game" but to retain their friendship, he applies his skills to help them rob banks. An allegory of engineering?

The Man Who Fell to Earth (1976): A very strange film in which David Bowie portrays an extraterrestrial who creates a giant industrial corporation in order to finance his way home. He is undone by shadowy corporate thugs who find his pace of innovation threatening.

The Man in the White Suit (1952): Scientists not only do not anticipate the likely negative impact of their researches, but they are so monomaniacal about their technical puzzles that they are incapable of learning the lesson even after the fact.

The Manhattan Project (1986): High school boy builds primitive nuclear weapon using public domain information and plutonium stolen from his mother's boyfriend's lab. The boyfriend is a physicist who lets the military use him so that he can get the funding to pursue laser isotope separation research. At an appropriately critical moment, the scientist is denounced for trying to pretend that he is any better morally than the soldiers he scorns.

Medium Cool (1969): The relation between technologies and the realities they create is treated here by way of video recording and news events.

Metropolis (1926): A surrealistic critique of industrial capitalism, in which the capitalists seek to build workerless factories and a genius scientist creates a robot for them. Again, the technical challenge of scientific problems is so fascinating that the scientist is blind to their moral implications.

Modern Times (1936): Chaplin's film, too, is a critique of industrial capitalism and especially of the allegiance of the police to the rich. Along the way the moving assembly line and factory work generally are depicted as dehumanizing, but Chaplin's character is not a representative of the downtrodden. The funniest scene has Chaplin selected to demonstrate a machine that increases productivity by feeding workers as they stand at their work stations.

Mon Oncle (1957): Monsieur Hulot's sister is married to a plastic-tubing manufacturer and lives in a "modern," high-tech, house. Hulot does not succeed in the factory job his brother-in-law offers him, but he succeeds in making low-tech French living look far more pleasant than the high-tech version.

The Mosquito Coast (1986): The central character is an iconoclastic engineer of talent who undoes his triumphs by pushing his personal visions too far. He builds a huge, highly innovative ice machine in the Central American jungle because ice has never been there before—"Ice is civilization"—and sets about improving the creation God made a poor job of. A bit heavy-handed but a pointed statement of the disaster implicit in imposing human will on nature.

Mr. Hulot's Holiday (1952): Ellulian technique manifests itself in the organization of leisure at a Butlin's-style vacation resort; Monsieur Hulot does not adapt.

Ma Nuite chez Maude (1969): A Catholic engineer talks a very great deal to Maude and an old college friend about life and values, does not have the affair Maude offers because of his principles, and marries the girl he meets in church, who turns out to have been the mistress of Maude's ex-husband.

1984 (1956, 1984): A high level of technological sophistication correlates with the intensity of oppression, but does not cause it. On the other hand, it does not correlate with the advance of personal or social well-being either, as the oppressors may well apply new technologies to new oppression. *Brazil,* too, makes this point, in a very different way that says more about technology and society.

No Highway in the Sky (1951): Jimmy Stewart portrays an unbelievably absent-minded mathematician who goes to work for a pioneer turbojet passenger plane manufacturer. He develops a metal fatigue model that predicts wing failure early in the plane's duty cycle, but at first he has a hard time convincing anyone to listen to him. The depiction of the science "boffins" is incredible, as was the decision to cast Marlene Dietrich as Stewart's costar. As in *The China Syndrome,* truth came hard on the heels of fiction, in this case in the form of the early Comet jetliner disasters.

On the Beach (1951): Like the preceding film, this was also based on a Nevil Shute novel, about Australians awaiting the radiation from the nuclear war that has killed everyone else in the world and will soon kill them. The contrast with *The Quiet Earth* is interesting for two ways of saying the same thing.

Paris, Texas (1984): German director Wim Wender's vision of America as a country in which human contact is mediated by technology, to the detriment of the contact. Ludicrous casting of Nastasia Kinsky as a young Texas woman, but

the recurrent recourse to technologies that insulate us from personal experiences is disturbingly accurate.

Playtime (1968): Jacque Tati's most mordant Monsieur Hulot film, mocking the destruction of French culture by the high-technology international style. The climactic episode is the self-destruction of an ultramodern night club on its opening night and the spontaneous formation of an old-fashioned bistro in the rubble.

Project X (1987): The U.S. Air Force decides to train chimps to fly suicidal nuclear bombing missions. The training process requires exposing the test animals to lethal doses of radiation to monitor their reaction to the real thing. The staff scientists have no problem with this, but a young airman and a lovely primatologist do.

The Quiet Earth (1985): Another Australian film in which (almost) everyone on Earth dies, this time as a result of an American defense experiment that goes awry. A scientist who opposed the experiment, and who survives for a while, delivers a panegyric on power and the misuse of knowledge that is heartfelt, but sophomoric.

Return of the Jedi (1983): Yet again the out-gunned rebels triumph: technology loses out to heroism and heart every time, though not without losses. Perhaps the dark side of the Force and the dark side of technology are meant to be compared.

The Right Stuff (1983): Not at all a paean to the space program, but a portrayal of the triumph of strong-willed, heroic men over the unheroic politicians, technocrats, and media clowns who make their heroism possible, but at a high personal price.

The Road Warrior (1982): The second film in the Mad Max series, after Max's wife and child have been murdered and he is a loner, unattached to the police. He is tougher than hobnails, but a helluva driver and incapable of not doing some good that falls his way. This time he gives a commune of technicians and engineers the opportunity to escape slaughter and continue rebuilding civilization.

Robocop (1987): Two technical approaches to applying robot technology to the business of police services: a human-machine hybrid and yet another "fail-safe" intelligent robot (see *Westworld* and *Futureworld*). Both are the cynical product of corporate machinations, again raising the specter of vested interests corrupting the latent promise of new technologies.

Seconds (1966): An unusually thoughtful film about the limitations of technology as a solution to human problems. Here, wealthy senior executives are offered a second chance at life by having their brains transplanted to young adult bodies. The condition is that they must not attempt to return to their former lives, but Rock Hudson's love for his wife drives him to disobedience.

Seven Days to Noon (1950): A variation on the mad scientist theme. A nuclear scientist cracks under the strain of Cold War tensions and tries to blackmail the world into peace. Just a little bit like the engineer in *The China Syndrome.*

Short Circuit (1986): The U.S. Army funds a program to develop advanced AI battle robots, but in an accident one of them becomes . . . alive, and wants neither to destroy nor to be destroyed.

Silkwood (1983): Based on the events of Karen Silkwood's life surrounding her work at a Kerr-McGee nuclear parts plant, including her radiation contamination and her death en route to a meeting with a *New York Times* reporter to give him "proof" that the plant she worked in was a plutonium sieve.

Simon (1980): Marshall Brickman's first film as a director is a comedy that pillories the ethics of scientific think-tank researchers. Alan Arkin portrays a psychologist cynically manipulated by a research group. In one pantomime sequence he recapitulates the evolution of life from one-celled marine creatures to the assembly line.

Sleeper (1973): At the end of this witty deflation of science, technology, and politics, Woody Allen's character announces that he believes in nothing, not even science: "Scientists are just a bunch of guys in tweed suits cutting up frogs on foundation grants."

Soylent Green (1973): The world is wildly overpopulated and hotter every year, the environment is irreversibly polluted, and food is in short supply. Edward G. Robinson portrays a research aide to piece-work cop Charlton Heston. He discovers that the newest soybean-lentil food chips are in fact reprocessed human flesh.

Splash (1984): A genuine mermaid, beautiful and English-speaking, surfaces in New York City. The scientist studying her can hardly wait to do an autopsy—after exhausting all *in vivo* tests, of course.

Spitfire (1942): A British morale booster that traces the creation of the Battle-of-Britain Spitfire from the vision of its designer, through his persistence over years of official indifference, to his willingness to work himself to death to meet the overt Nazi threat. A clear illustration of Edward Constant's thesis that innovation is driven by a vision of leapfrogging performance limitations.

Star Wars (1977): The Empire has the weaponry and the coldly rational Darth Vader; the rebels have wit, love, heart, and a pure version of the Force that Vader has corrupted, plus *enough* weaponry to do the job. In the climactic scene, Luke Skywalker's Jedi master tells him to turn his computer off and to guide his bomb run on the Imperial Deathstar by instinct!

The Stars Look Down (1941): Not about technology in the "high" sense, but perhaps a purer illustration for that of the institutionalization of power as a source of human misery. Here, it takes the form of the suffering of Welsh coal miners and their appalling working conditions, suffering due largely to the greed of the mine owners.

The Story of Alexander Graham Bell (1939): A successful film perhaps, but a ridiculous depiction of Bell and Watson pursuing the invention of a telephone, then defending their patent right in court. *Madame Curie* does a better job of conveying a sense of scientific research as a vocation.

The Thing (1951): An alien life form is discovered frozen in Arctic ice by a group of scientists and Air Force personnel. The naïveté, stupidity, and callous

self-centeredness of the scientists, overriding the common sense and good-naturedness of the military personnel, results in the creature being thawed out and running amok. Compare to *Iceman.*

THX 1138 (1971): George Lucas's first film. A high-technology futuristic society in which sex and love are proscribed, predictably to little avail. Again, technological advance does not improve the human condition; it simply makes the job of oppressing the masses easier.

The Terminal Man (1974): A high-technology "solution" to controlling the violent outbursts of a psychomotor epileptic: an embedded telemetry unit links the patient to a computer that senses the onset of attacks and stimulates a pleasure center in the brain to avert it. The patient subverts the technology and becomes still more violent. Moral: technological solutions are seductive, but watch out!

The Terminator (1984): Automating the U.S. and Soviet defense systems is not a good idea in the sci-fi world, so somebody ought to let the SDI Office in on this. Here is yet another film in which this move precipitates mutual nuclear destruction "accidentally." Worse still, here you get Arnold Schwarzenegger as a robot killer sent to sew up loopholes in the renegade computers' "final solution" to the human problem.

Things to Come (1936): H. G. Wells's fictional "history" of the future, *The Shape of Things to Come,* gave the Technocracy movement its widest airing, but the film is only loosely based on it. Engineers intervene after decades of world war and create a prosperous, peaceful society under benevolent technocratic despotism. The masses revolt, however, led by an artist, because continual innovation is irritating and the scale of technological achievement beggars all other forms of human accomplishment.

The Trail of the Lonesome Pine (1915, 1936): Based on a turn-of-the-century best seller, one of many from this period featuring engineer heroes. The film depicts personal conflicts generated by the coming of the railroad. The figure of the engineer. however, is pure progress.

Tron (1982): Disney's timing was off: this film was released in the wake of the collapse of the first video game "bubble." Interesting for providing a story line that gives a positive twist to what many adults were saying darkly: that their children were being enslaved by their computers. Technologically, a watershed in cinema computer graphics.

Tucker: The Man and His Dream (1988): Coppola's story no less than Tucker's? An innovative genius is crushed through corrupt means by rivals who are unwilling, or unable, to compete with him. Engine location apart, after three decades of Big Three opposition, many of the Tucker's safety features are standard today.

2001 (1968): Apart from everything else about it, the film raises the question of the human consequences of implementing technologies so sophisticated that they must be ceded crucial control decisions. Also, technological achievement appears puerile by comparison with the power of the incorporeal life form our space technology puts us into contact with. How should we be developing?

2010 (1984): A more decisive encounter with the sentient "energy cloud" (?), more technological tomfoolery, and the opportunity to eavesdrop on HAL's psychotherapy, but the Russian film *Solaris* (1972), based on a Stanislaw Lem novel, is much better on this.

Virus (1980): Intensely sincere antimilitarist film warning against developing biological weapons and (you guessed it) automating the U.S. and USSR ICBM systems. A U.S.-developed viruslike organism is stolen by the East Germans. They lose control of a sample, which is released after a plane crash and kills everyone in the world except those at Antarctic research stations. Most of the latter are killed after an earthquake triggers the U.S. Automated Reaction System, which triggers the Russian system, both systems having been armed by dying military zealots.

War Games (1983): *Colossus: The Forbin Project* with teenagers, an even less appealing computer scientist, and another computer-controlled ICBM system. This time there is a happy ending and the military oppose computer control for a change.

Weekend (1968): Godard's surrealistic reduction of human existence to two problems: coping with an epochal traffic jam *cum* mass traffic accident and rebelling against the system that makes this metaphor for technology-intensive society the horizon of human existence.

Westworld (1973): Michael Crichton again, and again warning about complacency in dealing with our technological "toys."

Who Framed Roger Rabbit? (1988): The film defines the current state of computer graphics art and is also about technology. The plot revolves around the efforts of Judge Doom to shift Los Angeles from mass transit to freeways and private autos. To do so, he buys Pacific Electric Railway in order to bankrupt it. All he needs is control of Toon Town to get the freeways started.

Wizards (1977): In this Ralph Bakshi animation, twin brothers follow different paths in a post-nuclear war world. One becomes a "Hitler" to evil mutant armies he equips with World War II-era weapons. The other becomes a sybaritic guru to decent yeomen who eschew technology as the root of evil, but cannot defend themselves against the latest onslaught. Reluctantly, the guru leads a "fellowship" of brave souls to enemy headquarters where, to our surprise and the brother's, he whips out a pistol (enemy technology) and kills his sibling. The allegory is transparent, but only a little less trenchant for that.

Zardoz (1974): Scientific knowledge permits an intellectual elite to live well, and virtually forever, in a post-nuclear war world, by dominating brutish survivors. But science turns out not to be enough to generate happiness, let alone justice and the good life. The technological veil must be torn to let human passion and instinct rebuild the world, even though it means the destruction of the elite communities and the loss of immortality. *Zardoz* and *The Emerald Forest,* both John Boorman films, reach the same conclusion about technology: destroy it and let the primitive work itself out!

Notes

1. Dates, and brief annotations, for all of the films mentioned here are listed alphabetically in the accompanying filmography.

2. An unusual, and particularly telling, illustration of this trend is described in Bruce Sinclair's 1986 essay, "Local History and National Culture: Notions on Engineering Professionalism in America." Sinclair summarizes the storyline of a play, *Every Engineer: An Immorality Play,* written and presented to the public by the Engineers Club of St. Louis in 1931 as its contribution to the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers. In the play, an engineer moves from youthful enthusiasm, loyalty, and professional virtue to growing disillusionment as he confronts the selfish and unprofessional exploitation of technical expertise that is his employer's customary code of business conduct, to bitterness when he resigns and discovers that even as an independent consultant he can only obtain contracts by playing management's game.

3. This is discussed in Goldman (forthcoming).

4. See, for example, *Technology in the Modern Corporation: A Strategic Perspective,* edited by Mel Horwich (1985), especially the following: John Friar and Mel Horwich, "The Emergence of Technology Strategy: A New Dimension of Strategic Management"; Margaret B. W. Graham, "Corporate Research and Development: The Latest Transformation"; and Graham R. Mitchell, "New Approaches to the Strategic Management of Technology."

5. After the climactic battle when, with Gatling gun and electrified fences, the Boss, Clarence, and 52 teenagers have slaughtered 25,000 attackers, they are trapped within the walls of corpses and await their own death. The common treatment of this book as a comedy based on technologically "one-upping" the primitives obscures Twain's deeply pessimistic message about the irrelevance of technological wonders to the development of human nature.

6. These are only a small fraction of the apposite works. I mention them because they were singled out for rebuttal by Samuel Florman in chapter 4 of his *The Existential Pleasures of Engineering* (1976). Lewis Mumford's *The Myth of the Machine* (1967 and 1970), Langdon Winner's *Autonomous Technology* (1977), Ivan Illich's *Medical Nemesis* (1976), Theodore Rozsak's *The Making of a Counter-Culture* (1969), and the series of books by Carlos Castaneda (1971) purporting to espouse the teachings of a Yaqui sorcerer, don Juan Matus, are some other particularly relevant works.

7. A collection of essays examining the relationship of science and technology to social progress from a wide variety of political, philosophical, and methodological perspectives is Goldman, *Science, Technology, and Social Progress* (1989).

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